Brief

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Earthquake Hazard Assessment Along Designated Emergency Vehicle Priority Access Routes

Research Development and Technology

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Introduction

Geologic conditions in southeast Missouri make this region one of the most seismically susceptible in the country, based on its damage potential from intrinsically susceptible soil, high ground water levels and vast expanses of flood sensitive ground. If a high magnitude earthquake struck southeast Missouri today, infrastructure in the area would be devastated. Levees and dams could be breached. Bridges across the Mississippi and Missouri rivers could collapse or be rendered unusable. Landslides, floods, soil liquefaction, and the failure of roadway bridges and overpasses would close extended sections of highway. The network of lifeline facilities and services required for commerce and public health in St. Louis, Sikeston, Cape Girardeau and surrounding communities would be devastated. Utilities, including electrical power, communications, oil and gas distribution, sewage disposal and water distribution, would be disabled until emergency repair crews were able to access these communities. Southeast Missouri would be effectively cut-off from the rest of the world and individual towns and communities isolated.

Statement Of Problem/Scope Of Work

The designated emergency vehicle priority access route into St Louis and southeast Missouri include portions of MO 100 and US 60, respectively. These routes traverse varied geologic settings and include or cross many critical roadway features such as bridges, slopes, box culverts, and retaining walls. The extent of damage and survivability of these critical roadway features in the event of a major earthquake event is not fully known and would impact the ability to use these designated routes to provide emergency vehicular access in a timely manner.

This study involves the assessment of four critical bridges at two sites along US 60 and the development of an initial geotechnical database that will be part of a future regional geotechnical database. The methodologies developed in this study will be used to establish an assessment protocol. The output-interpreted geotechnical data will be used for future prioritization and retrofit of deficiencies noted at the bridge sites studied.

Objectives

There were two primary objectives for this study. Objective 1 was to establish a geotechnical database for earthquake design and future use in a geographic information system (GIS) for the portions of US 60 and MO 100 in the counties of Butler, Stoddard, New Madrid, Franklin and St. Louis. Objective 2 was to conduct detailed earthquake assessments at two sites along designated emergency vehicle priority access route US 60.

Conclusions

Geotechnical GIS Databases

Databases have been established for earthquake design data for the US 60 corridor in Butler, Stoddard and New Madrid Counties and for the MO 100 corridor in Franklin and Saint Louis Counties. This includes appropriate data from Missouri Department of Transportation files.

Site Specific Earthquake Hazards Assessments

Detailed earthquake site assessments were conducted for two critical US 60 roadway sites (Wahite Ditch Site and St. Francis River Site). Site assessments included: subsurface exploration, and laboratory testing to identify subsurface materials and their engineering properties; evaluation of available seismic records and procedures to characterize the ground motions associated with various design earthquake events; and evaluation of the response of the subsurface materials and the existing bridge structures to the estimated ground motions.

The site assessments at these two locations included the following:

1. Estimates of peak magnitude and duration of ground surface motion (including amplification/damping) associated with various events at each site.

2. Evaluation of the susceptibility of each site to quake-induced slope instability, liquefaction and flooding.

3. Estimation of the shaking effects on the various types of existing bridge structures at each site.

4. Comparison of the ground motion and structural response parameters from site-specific earthquake analysis method with those from AASHTO response spectrum analysis method, and preliminary guidance regarding selection of the analysis method at future sites.

5. Evaluation of modified site assessment techniques and establishment of a basis for using these modified techniques at other sites along designated emergency access routes.

Site-specific seismic response evaluations or the four study bridges were completed. Liquefaction potential, slope stability, abutment stability, flooding potential, and structure stability analysis were performed at both sites for selected "worst case scenario bedrock ground motions" with PE of exceedance of 2% and 10% in 50 year, respectively. Ground motion analysis utilized synthetic ground motions for a New Madrid and other, source zones. Results are presented in the report (.PDF, 15 Mb, 389 pages).